National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology

JUPITER ICY MOONS ORBITER

Pre-Proposal Briefing

February 18, 2003

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AGENDA

▪ Introduction	J. Casani
▪ Program Overview	Ray Taylor
▪ Project Overview	J. Casani
▪ Science	T. Johnson
▪ Safety & Mission Assurance	S. Kayali
▪ Acquisition Strategy	Randall Taylor
▪ Contract Management and System Engineering	D. Lehman
▪ Request for Proposal	K. Hahn
▪ Statement of Work & Exhibits	K. Clark / H. Price

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CONFERENCE PURPOSE

Jet Propulsion Laboratory
California Institute of Technology

- Pre-proposal conference is designed to:
  - Introduce the JIMO Project
  - Provide an overview of the project implementation plan
  - Provide an introduction to the industry Phase A work plan
- Session should prepare you to:
  - Ask questions at the 1-on-1 dialogue (tomorrow)
  - Provide comments on the draft RFP (tomorrow, and by Thurs. noon PST submitted in writing to the Contract Negotiator)
  - Quickly respond to the official RFP (to be issued Fri.)

1-on-1 DIALOGUES

- 1-on-1 dialogues are designed to:
  - Briefly introduce team capabilities
  - Provide an opportunity to ask questions about the draft RFP and the Project
  - Provide comments on the draft RFP
- Meeting ground rules will be reviewed at the start of each session
- Nothing in the sessions is official, nor should be relied upon
  - Contract Negotiator will distribute questions & answers to all study contractors
  - Any changes to the draft RFP will be distributed in the form of the official RFP

PROJECT PROMETHEUS

JUPITER ICY MOONS ORBITER

Ray Taylor

Pre-Proposal Briefing
February 18, 2003

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PROJECT PROMETHEUS Origin and History

Jet Propulsion Laboratory
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President's FY03 Budget (NASA)

NASA *Nuclear Systems Initiative*

- Nuclear Power (space radioisotope power system development)
  - Reestablish capability to fabricate space radioisotope power systems to support deep space and planetary surface exploration
- Nuclear Propulsion (advanced space technology research and development)
  - Revolutionize solar system exploration through the research and development of advanced fission-based space propulsion and power technologies

Based on detailed technical analysis and industry surveys during 2003, confidence to propose new FY04 mission initiative.

President's FY04 Budget (NASA)

NASA *Project Prometheus*

- Nuclear Power (radioisotope Power System Development)
  - Reestablish capability to fabricate space radioisotope power systems to support deep space and planetary surface exploration
- Nuclear Propulsion (advanced technology research and development)
  - Revolutionize solar system exploration through the research and development of advanced fission-based space propulsion and power technologies
- Jupiter Icy Moons Orbiter (mission development)
  - Responsive to Decadal Survey and Aerospace Commission recommendations, survey in unprecedented detail three icy moons of Jupiter, enabled by fission-based space propulsion and power technologies

Chronology of JIMO Preparatory Activities

- Feb 2002
  - NASA Nuclear Systems Initiative proposed in President's FY03 budget
- Jul 2002
  - NASA Request for Information (RFI) released to industry for information on systems and technologies for nuclear propulsion
  - Initiated mission analysis studies of a range of potential missions
- Aug 2002
  - Initiation of DOE / NASA reactor concepts and power conversion assessment study
- Sep 2002
  - Industry responses to NASA RFI
  - Initiated Jovian Icy Moons Tour (JIMT) mission studies (3 options)
- Sep – Oct 2002:
  - Industry briefings to NASA / DOE on responses to NASA RFI
- Nov 2002
  - Initiated Jupiter Icy Moons Orbiter (JIMO) project formulation activities
  - (Nov 26) Space Reactor Power System Screening Study briefing to industry and DOE RFI
- Dec 2002: Industry responses to DOE RFI
- Jan 2003: Completed review of Jovian Icy Moons Tour (JIMT) mission studies
- Feb 2003
  - NASA Jupiter Icy Moons Orbiter (JIMO) proposed in President's FY04 budget
  - Draft JIMO Phase A Request for Proposals (RFP) released for comment
  - JIMO Project Office briefing to industry on JIMO and draft Phase A RFP
- Mar 2003
  - JIMO Phase A contracts award

FY03 Budget Request and Appropriations

- President's FY03 NASA Budget Request
  - Nuclear Power (radioisotope power system): $79.0 M
    - Note: Separate Mars Program budget request for radioisotope power systems of $9M
  - Nuclear Electric Propulsion (research): $46.5 M
- FY 03 Appropriations Bill: Veterans Affairs, Housing and Urban Development, and Independent Agencies
  - Note: Pending signature by President
  - *National Aeronautics and Space Administration*
    - Science, Aeronautics, and Technology
      - **Space Science**
        - » "2. An increase of $20,000,000 for the Jupiter Icy Moons Orbiter (JIMO) program.
        - » 12. A decrease of $10,000,000 to the Nuclear Electric Propulsion program.
        - » 13. A decrease of $9,000,000 to the Nuclear Power program."

PROJECT PROMETHEUS
Technology Development

- NASA will fund certain JIMO-related technology development work during Phase A and beyond
  - -NRA-awarded (see next slide)
  - -Directed work at the NASA Centers and DOE Laboratories
  - -Possibly certain industry efforts (nuclear fuel process recapture)

- Starting with Phase B, the selected system contractor will be responsible for additional technology work required by JIMO

Potentially JIMO-relevant NRA Awards

- 6 In-Space Propulsion Program Phase 1 awards announced September ’02 - tasks to be transferred to Project Prometheus in FY’03
- 3 Electric Propulsion - $200-300k Phase 1, $3-3.8M Phase 2 (each)
    - GRC: High Power Electric Propulsion (HiPEP) [Ion]
    - JPL: Nuclear Electric Xenon Ion System (NEXIS)
    - Stanford: Two-Stage Bismuth-Fed Hall Thruster with Anode Layer
- 3 Power Conversion - $1M Phase 1, $6M Phase 2 (each)
    - JPL: Segmented Thermoelectric Multicouple (STMC) Development
    - Boeing: [Brayton] Power Conversion Technology for NEP
    - ORNL: Potassium Rankine Cycle Power Conversion System

Jupiter Icy Moons Orbiter Project Overview

John Casani

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February 18, 2003

PROJECT OBJECTIVES

- Technology
  - Develop a nuclear reactor powered spacecraft and show that it can be processed safely, launched safely, and operated safely and reliably in deep space for long-duration deep space exploration
    - Subsidiary to this major objective is the development of nuclear fission technology and associated system technologies preparatory to demonstrating their effectiveness in deep space exploration
- Science
  - Explore the three icy moons of Jupiter – Callisto, Ganymede, and Europa and return science data that will meet the highest scientific goals as set forth in the Decadal Survey Report of the National Academy of Sciences.
    - The high power and high data rate afforded by nuclear power will enable science data return that is unprecedented in quality and quantity.

PROJECT SUMMARY

- Managed by JPL including DOE and NASA Center Support.
- Conducted as an element of Project Prometheus Program.
- Responsible for managing the development of technologies that are required to complete mission objectives
- Will use NASA’s Announcement of Opportunity process to solicit scientific instruments/investigations that can profit from power, trajectory options, and communications capabilities that nuclear fission sources can enable.
- Phase C/D implementation of the Project will begin in FY2006, with pre-formulation and formulation studies beginning in September 2002.
- The Space system is planned for launch in the year 2011 or 2012. EOM is expected to be no later than the year 2023.

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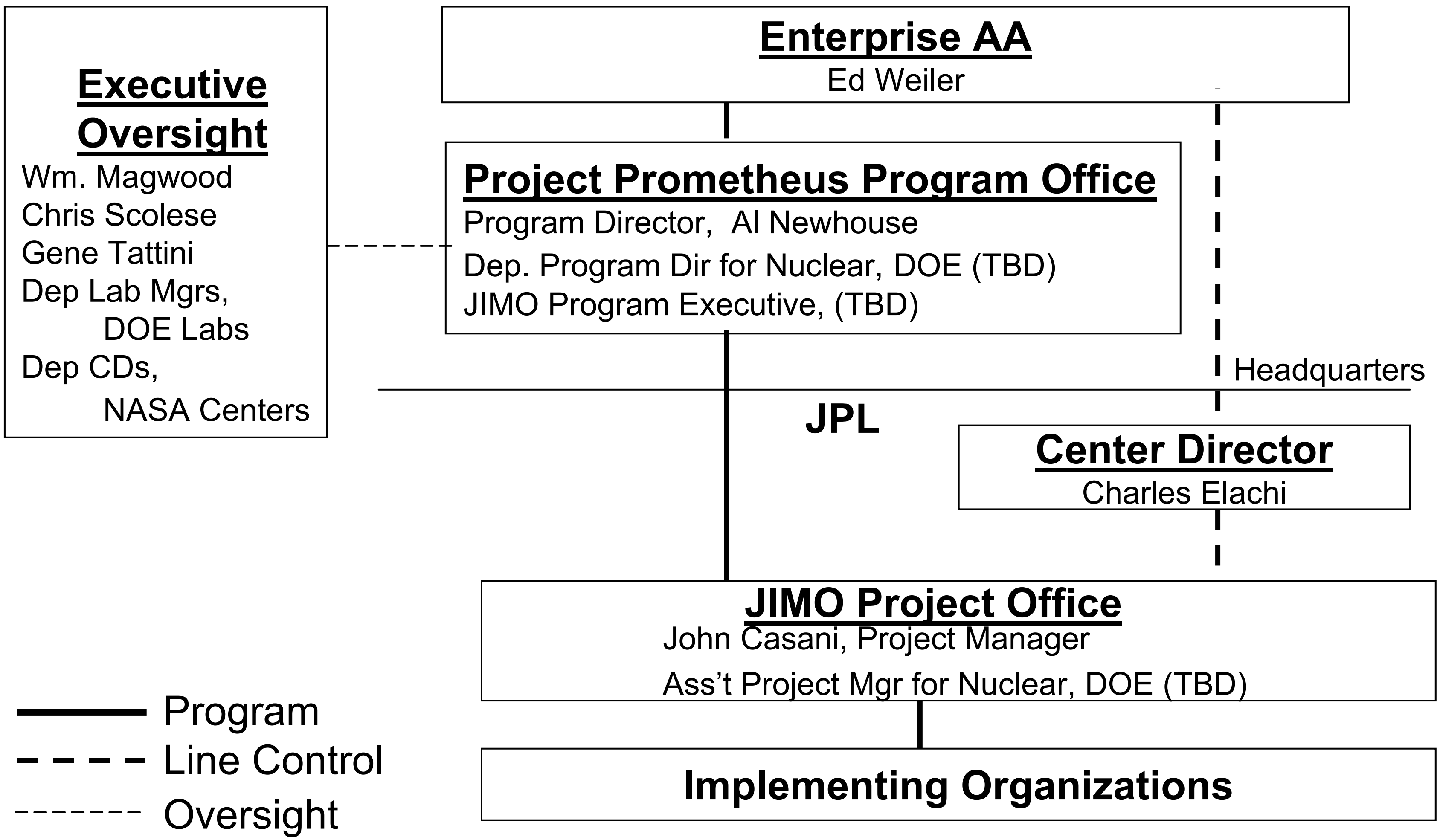
ORGANIZATION

Jet Propulsion Laboratory
California Institute of Technology



Project Office

Proj Science Group
Project Scientist (JPL)
PIs, TLs, IDSs

Project Office
Project Manager (JPL)
Ass't for Nuclear (DOE)
Ass't for Bus Ops (JPL)

Mission Assurance Requirements Office
Mgr. (JPL)
Dep. (DOE)

Business Office
Ass't for Bus Ops (JPL)

Safety Office
Mgr. (DOE)
Dep. (JPL)

Technology Office
Technology Mgr. (JPL)

Engineering Office
Project Engineer (JPL)

Science and Mission Design Office
Project Scientist (JPL)
Office Manager (JPL)

Space System
Mgr. (JPL)

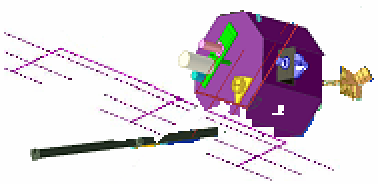
MO System
Mgr (JPL)
Dep. (Prime)

Launch System
Mgr. (KSC)

JIMO WBS Architecture and Terminology

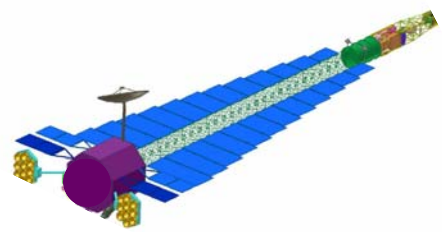
3.0 Space System

3.4 Mission Module



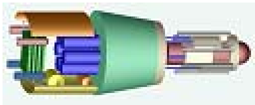
Bus Mounted Instr
Scan Platform Instr
Turntable Instr
Lander

3.3 Spacecraft Module



S/C Bus
Reactor Power Conversion
Electric Propulsion
LV Adapter (not shown)

3.2 Reactor Module

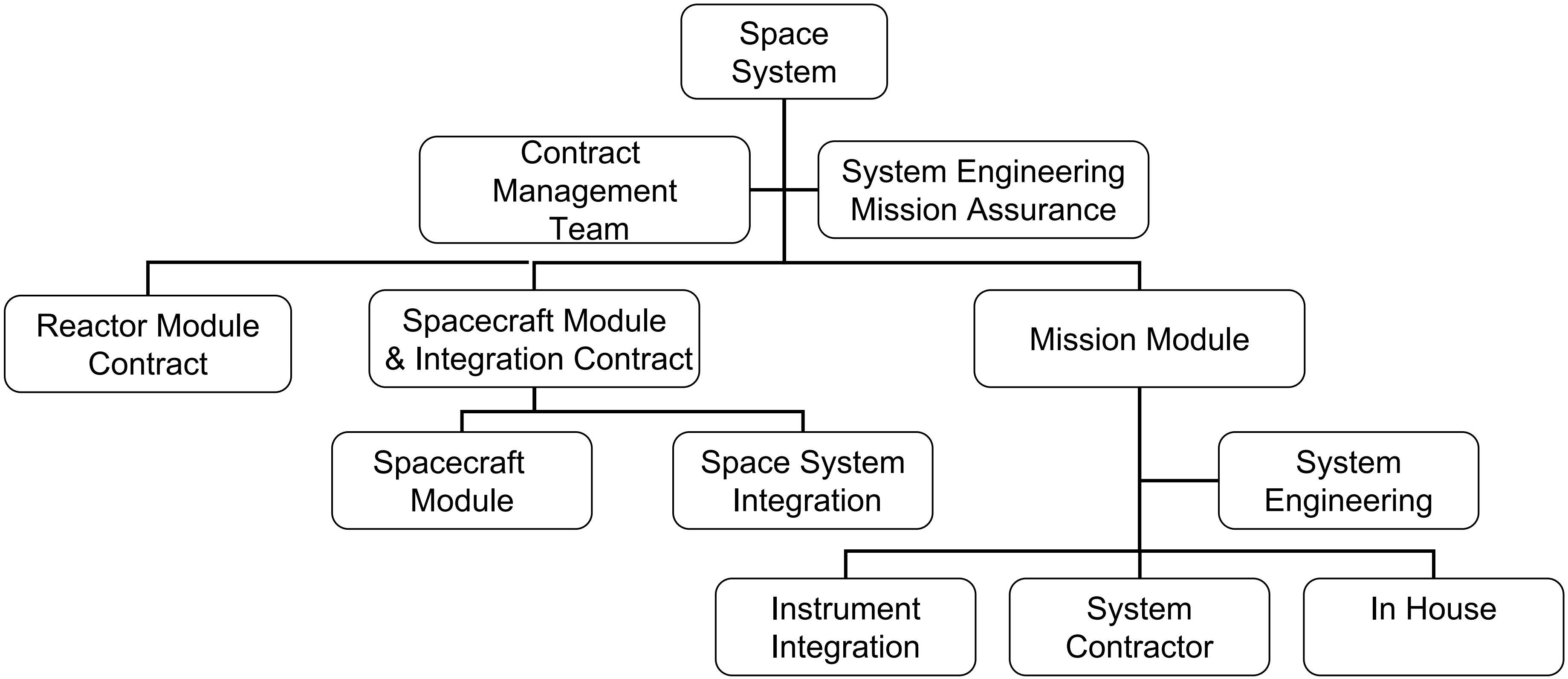


Reactor
Radiation Shield
Re-entry Shield
Reactor Instrumentation & Control

Mission specific science payload

Feed forward multi-mission opportunity

Space System Organization



IMPLEMENTATION SUMMARY

- JIMO Project Office is located at JPL and will jointly be staffed by persons from JPL, other NASA Centers, the DOE, and/or DOE laboratories
- Project Office staff will perform project management, project system engineering, project safety and mission assurance, mission design, and mission operations management.
- Contract, Phases B/C/D
  - A contract for the Spacecraft Module and integration of the entire Space System wil be led by JPL to an aerospace contractor
  - A separate Reactor Module contract will be led by the DOE to a Reactor contractor.
  - Administration and technical direction of both contracts will be handled by appropriate persons from the respective agencies, collocated in the JIMO Project Office at JPL.
- JPL will provide the Mission Module, and selected elements of the Spacecraft Module.
  - These items and the Reactor Module will be provided as Government-furnished equipment (GFE) to the system integration contractor.
  - The JIMO Project may specify the use of certain equipment, such as specific radiation-hardened electronics, or certain software system implementation.

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Mission and System Overview

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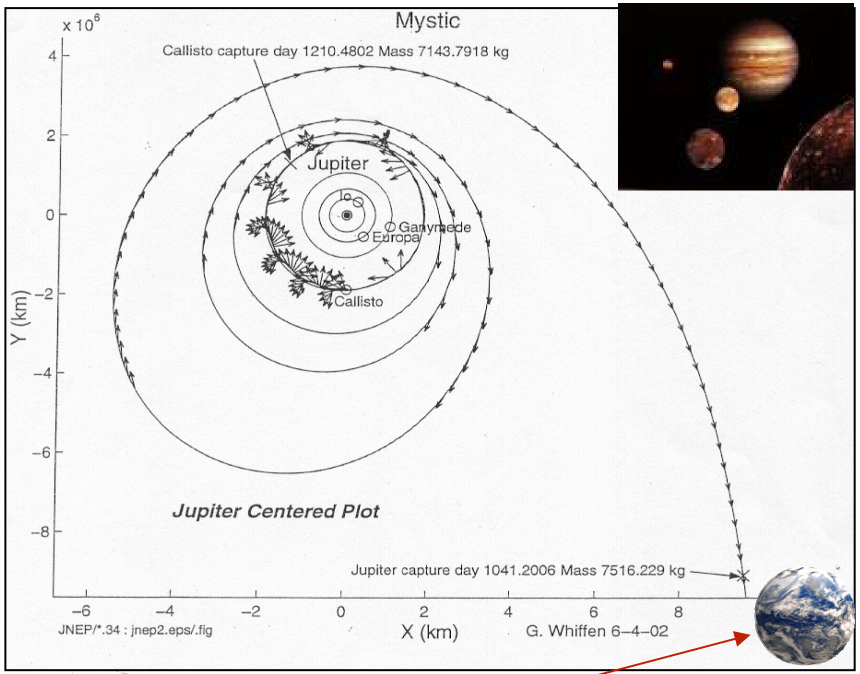
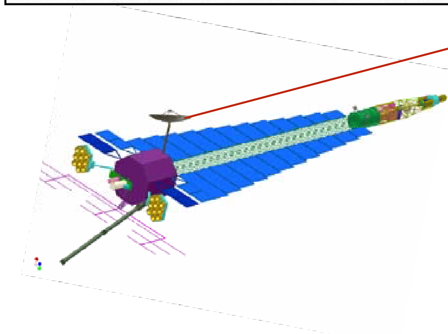
- Single Launch, May 2011
- S/C initialization (30 days)
  - Solar array deployment & sun acquisition
  - PPM boom, and radiator deployment
  - Reactor, Converter & EP startup (10 days)
  - System Checkout (20 days)
- Earth Departure: Spiral out (712 days)
- Interplanetary Cruise (6.0 years)
- Jupiter Spiral-in (348 day)
- Callisto Encounter (256 days)
- Jupiter cruise to Ganymede (277 days)
- Ganymede encounter (301 days)
- Jupiter cruise to Europa (280 days)
- Europa encounter (76 days)
- Spiral out to quarantine orbit (7 days)
- End of Mission





10 Mbps Data Return from Jovian System

JIMO NEAR-TERM SCHEDULE

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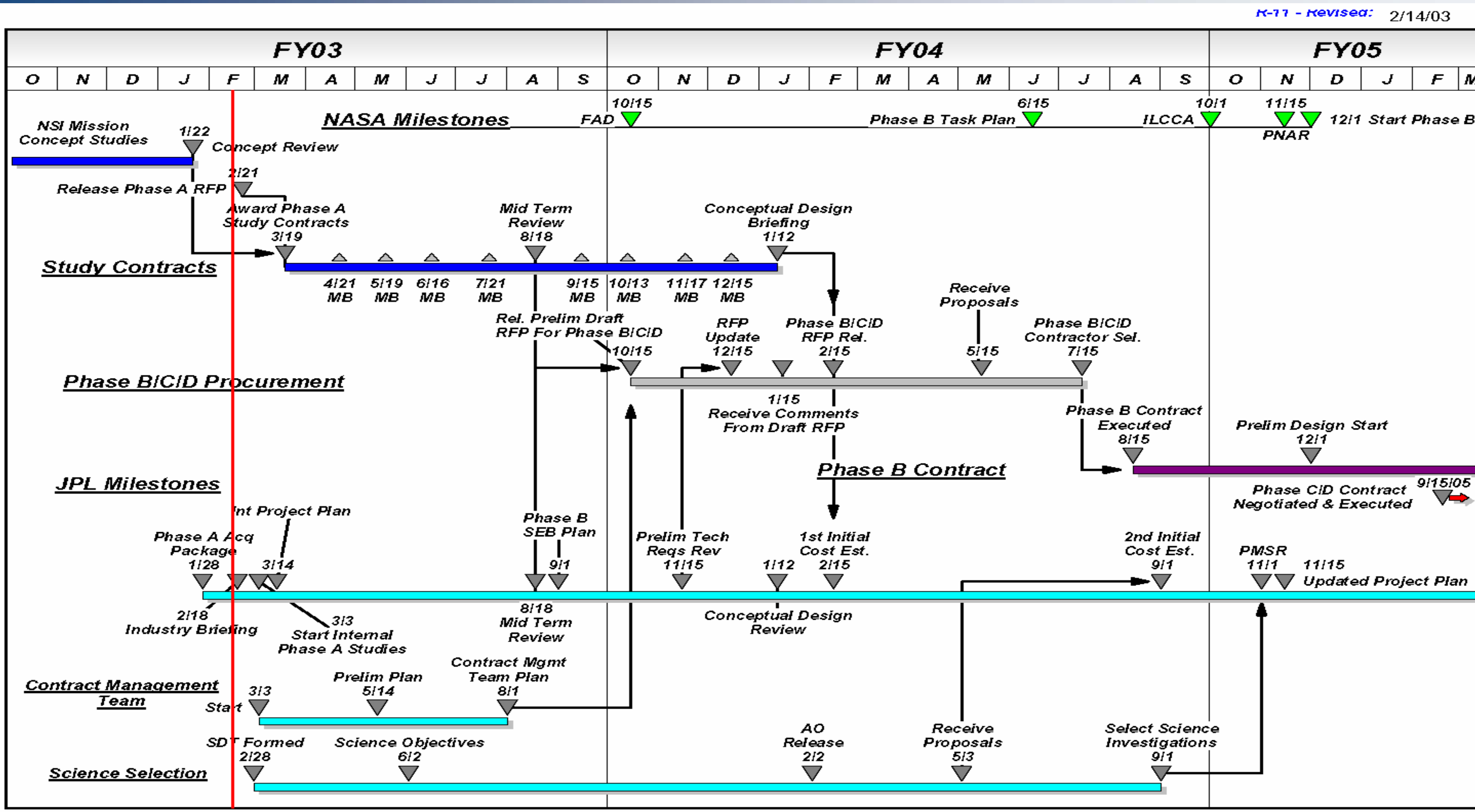

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Jupiter Icy Moons Orbiter Science Overview

Torrence V. Johnson

Pre-Proposal Briefing
February 18, 2003

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

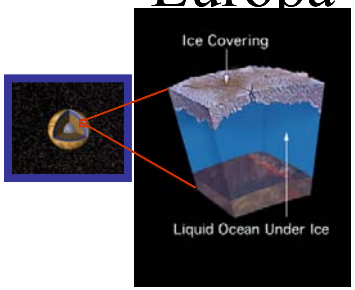
Jupiter Icy Moons Orbiter

Exploring the habitable water worlds of Jupiter

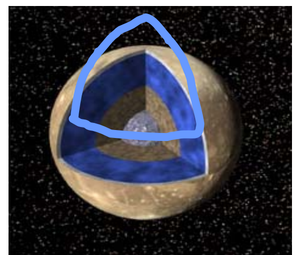
Water, Chemistry, Energy → Life(?)

Global Liquid Water Oceans

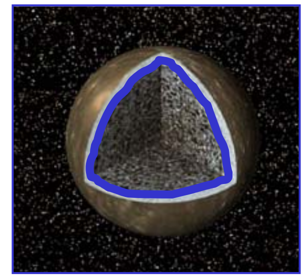
Europa



Ganymede



Callisto



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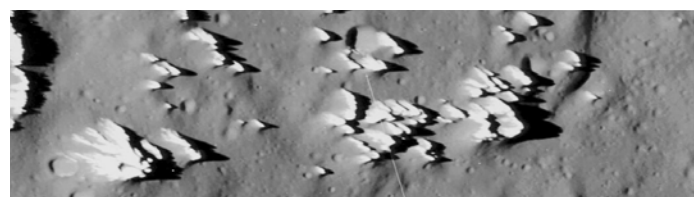
Geologically young surfaces with salts and organics



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Radioactive and Tidal Heating => **LIFE ??**

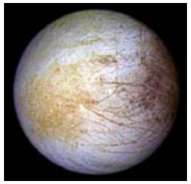
JUPITER ICY MOONS ORBITER
Science Background

- Europa, Ganymede, and Callisto very likely have global liquid water oceans beneath their icy crusts.

  …one of the major discoveries in solar system science in the last decade.
- There is spectral evidence for salts and organic materials on their surfaces, and geologic evidence that the Europan ocean may have been in contact with the surface in the geologically recent past (less than about 100 million years).

  … *these bodies are among the most exciting in the solar system for geophysical, geochemical and astrobiological exploration.*
- Strongly responsive to the Nat'l Academy of Sciences priorities
  – Europa orbiter was 1st priority flagship mission in Decadal Survey of solar system exploration

Charting the Water Worlds of Jupiter



Completely new level of exploration not possible with chemical propulsion orbiters:

Full orbital characterization of all three icy moons with the same experiment complement

- Confirm the existence of oceans on multiple Jovian moons
- Characterize ice crust thickness and ocean depth
- Identify areas on Europa where the ocean has recently exchanged with the surface and/or where the ocean is most accessible beneath the surface
- Locate and characterize organic material and begin the astrobiology exploration of these moons, identifying regions of prime interest for future exploration.

Science Investigations

- Science Definition Team formed by NASA to work with Project through Phase A
- Investigations to be selected through AO process at start of Phase B
- Types of investigations anticipated
  - Remote sensing: nadir pointed and scan platform
  - Space physics experiments
  - Geodesy from tracking, altimetry and gravity data
  - Landed package possible

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JOVIAN MOONS

Jet Propulsion Laboratory
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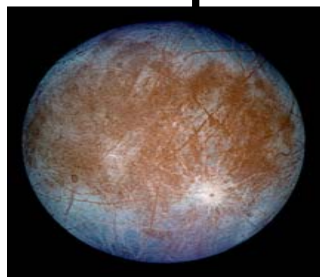
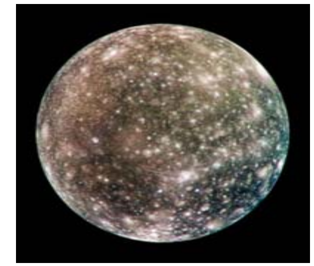
Europa | **Ganymede** | **Callisto**

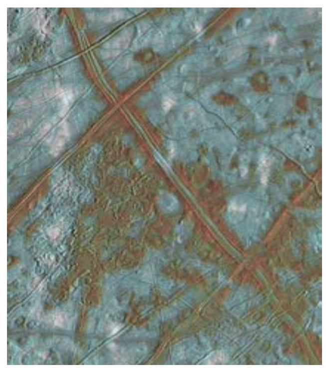
Resolution

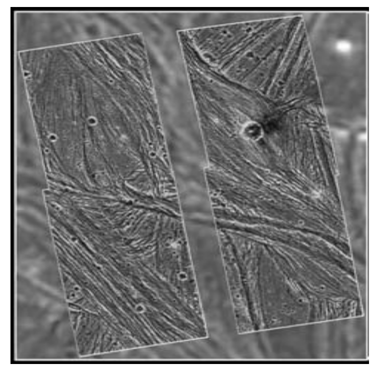
Voyager:
~10 km Global

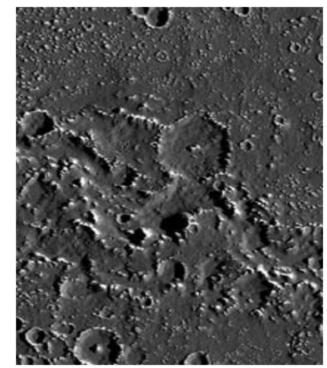




Galileo:
~100 m Regional

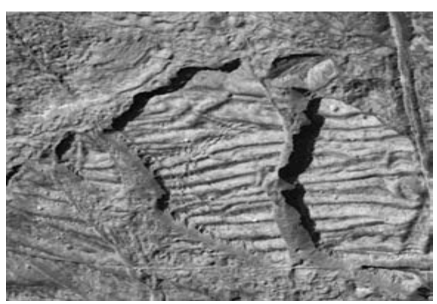


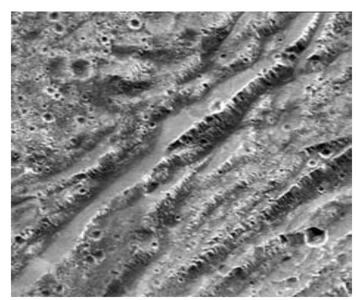


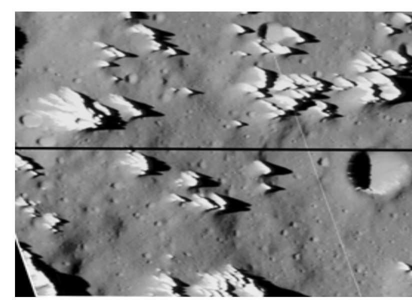


JIMO:
<10 m Global !!

(Galileo:
~10-20 m < 1%)







Jupiter Icy Moons Orbiter
Safety and Mission Assurance

Sammy Kayali

Pre-Proposal Briefing
February 18, 2003

Safety

- Safety is the absolute highest priority for the project
- Safety practices will be integrated and implemented across the project
- Safety plan will be generated and will include
  - Nuclear Safety
  - Personnel Safety
  - System Safety
  - Hazard Identification and Analysis Plan
- Conceptual Design Studies are expected to address the management of project safety including:
  - Credible Accident Scenarios
  - Space system or mission design options to mitigate potential for release of radiation or nuclear material in the earth biosphere during postulated credible scenarios
  - Safety test & analysis program
  - Recommended approach for integrated performance and safety analysis, compliant with the Atomic Energy Act requirements

Launch Approval Engineering

- Nuclear Safety
  - Safety is the absolute highest priority; reactor will be launched inactive; risk to the public and environment to be as low as reasonably achievable
- NEPA/LA Product Input
  - RFP
    - Identify credible accident scenarios that could result in a release
    - Identify and assess effectiveness of design options that could mitigate nuclear risk
    - Prepare a safety test and analysis program
    - Recommend an approach for integrated performance and safety analysis
  - Ad Hoc
    - System descriptive information, material properties, dimensions, mass properties...
- Nuclear Indemnification of DOE Contractors
  - Price-Anderson Act (amendment to the 1954 Atomic Energy Act) indemnifies DOE contractors

Risk Communication

- A coordinated proactive risk communication plan is being developed with industry as a partner
- For the plan to be effective, all participants must observe the following risk communication guidelines as required in the RFP:
  - Discussion of trades should always be in terms of science and engineering
  - Do not address issues unless you are a designated spokesperson for those issues
  - Prior to a NEPA decision being made, all plans should be designated as “baselined” or “proposed”
  - All media inquiries are to be coordinated in advance with Frank O’Donnell in JPL Media Relations Office: 818 354-7170 or Don Savage in NASA’s Public Affairs Office: 202-358-1227
- Coordination and review of all written material is essential
  - Risk communication questions are to be directed to Sandra Dawson @ 818 354-1240 or sandra.m.dawson@jpl.nasa.gov

Risk Management

- Manage the risks to accomplish the mission within the allocated budget and schedule constraints
  - Consistent with the NASA continuous risk management methodology (NPG 7120.5B)
  - Develop Project risk management plan describing the risk management process, integration, assessment and reporting
  - Maintain a project risk list and related mitigations

Mission Assurance

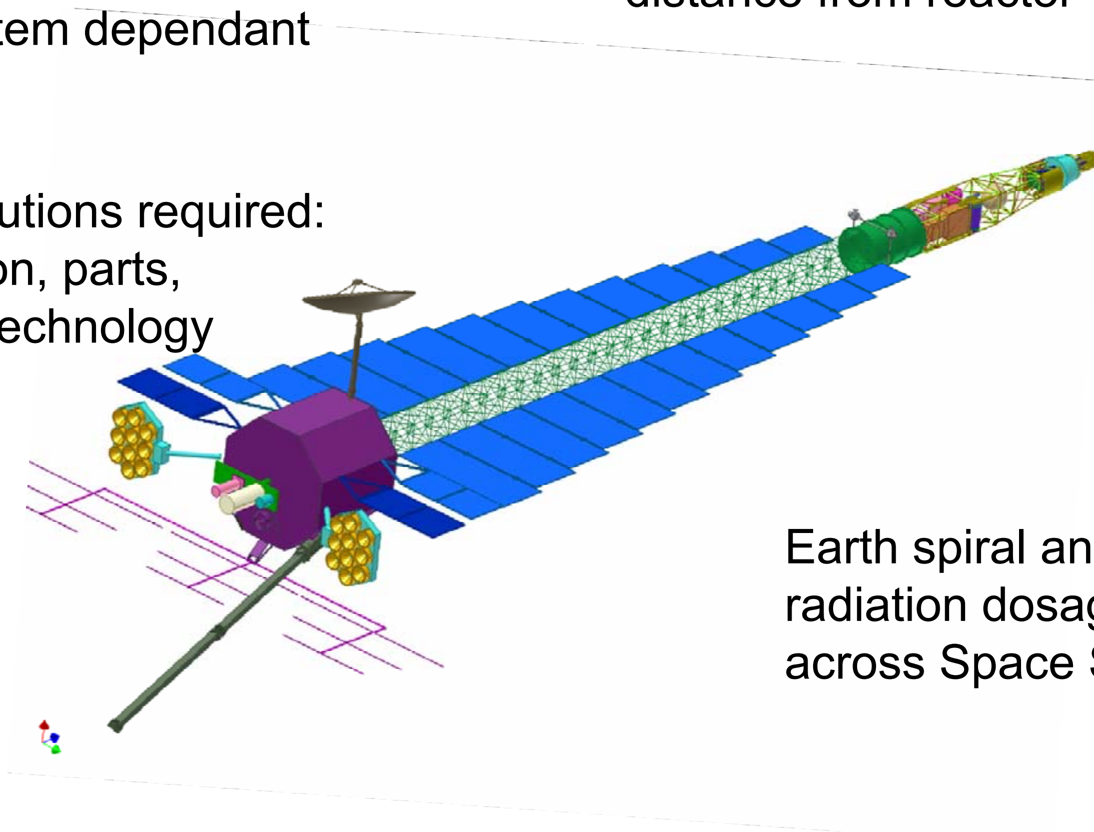
- Proactive identification, assessment and mitigation of risks. Integrated and implemented across the project to ensure mission success
- Led by JPL/DoE Mission Assurance Management Team
  - Utilize JPL Flight Project Practices, Long Life Design Rules, Lessons Learned, MA related Design Principles and Mission Assurance Principles as a baseline
- Mission Assurance activities will include:
  - Risk Assessment and Management
  - Environmental Requirements
  - Radiation Requirements & Verification
  - Electronic Parts Requirements & Verification
  - Mission Reliability Requirements & Verification
  - Hardware & Software Quality Assurance
- Conceptual Design Studies are expected to address the overall Mission Assurance elements management and implementation

Radiation Environment

Dosage at various points on Space System dependant on location

System solutions required: configuration, parts, modeling, technology

Neutron and gamma dosage falls off with distance from reactor



Earth spiral and Jupiter radiation dosage constant across Space System

Radiation Environment

- Conceptual Design Studies are expected to address:
  - Key radiation technology development needs
    - Parts development
    - Modeling
    - Analysis
  - Radiation mitigation & control plans
    - Shielding approach and design
    - Integrated system design and modeling approach for radiation survival
  - Radiation verification & analysis plans
    - Parts susceptibility to TID, Enhanced Low Dose Rate Sensitivity (ELDRS), Single Event Effects (SEE) & displacement damage
    - Worst Case Analysis & SEE Analysis
    - Charge leakage & spacecraft charging issues
    - Materials compatibility with radiation environment
    - Test & verification plans

Jupiter Icy Moons Orbiter Acquisition Strategy

Randy Taylor

Pre-Proposal Briefing
February 18, 2003

Acquisition Strategy - Phase A

- Phase A acquisitions are designed to mature the project and accomplish long lead activities
- Cornerstone procurement is the Study Contracts
- NASA Announcement of Opportunity (AO) will be issued 2/1/04 to solicit investigations
- Other procurements may be issued for long lead elements
- NASA-DOE Memorandum of Understanding (MOU) will be executed to document the Project Office, convey indemnification, etc.

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Acquisition Strategy - Phase A

- NASA/DOE/JPL roles will be included in the RFP after final decisions are made
- Project team will conduct "controlled interactions" with the Study Contractors and their teams during Phase A
  - "Rules of engagement" will be provided at the Contractors Kickoff Meeting
  - Rules will maintain a level playing field while providing insight to the Project and resources to the contractors

NASA CENTERS/DOE LAB PARTICIPATION IN JIMO

- Labs and Centers can have 4 roles in JIMO
  - Direct Contribution, e.g., facilities, consulting, design activities, deliverables
  - Independent Assessment, Technical Monitoring/Direction
  - Technology Development
  - GFE facilities
- NASA Centers will not participate as Direct Contributors in Phase A until after Phase B awards
- The DOE Labs participating as Direct Contributors in Phase A will do so at the invitation of the contractors and will not participate in Phase B RFP preparation, source selection, or project discussion or decision making
- Contractors are free to consider use of Labs and Centers after Phase A as Direct Contributors, provided a clear and unambiguous customer-supplier relationship is established, e.g., Contractors will provide funding, perform monitoring and assessment, and accept full accountability for performance and delivery
- Results from system contractor Phase A work will remain proprietary and competition sensitive.

DOE LAB PARTICIPATION

- If a DOE Lab participates in Phase A Study with Industry (they are, de facto, working as a subcontractor)
- Then the Lab will:
  - Not receive JIMO Phase A study money or JIMO technology development money. (All support money will come from contractor)
  - Not participate in Phase B RFP development
  - Have no role in technical monitoring or assessment of Phase A study work
  - Have no involvement in Project discussions or decision making

Acquisition Strategy - Phase B/C/D

- Single, streamlined SEB process will include one RFP, two Specimen Contracts, and one proposal
  - Spacecraft Module & Space System integration -- contract let & managed by JPL
  - Reactor Module -- contract let by DOE & managed jointly by JPL and DOE
- Each contract will be for Phase B work, with an option for Phase C/D/E
  - Additional options for three follow-on missions over a 10-year period
- Contracts will be managed by JIMO Project Office

Acquisition Strategy - Phase B/C/D

- Draft RFP will be issued 10/15/03 and updated 12/15/03, for industry comments
- RFP will be issued 2/15/04
  - RFP will identify GFE items (determined after the Phase A studies)
  - GFE will include Mission Module, specified elements of the Spacecraft Module, and reactor fuel pellets
- Source selection will be 7/15/04, followed by contract 8/15/04
- Investigation selections will be made 9/1/04 to support the industry preliminary design schedule

Jupiter Icy Moons Orbiter

Contract Management
and System Engineering

D. Lehman

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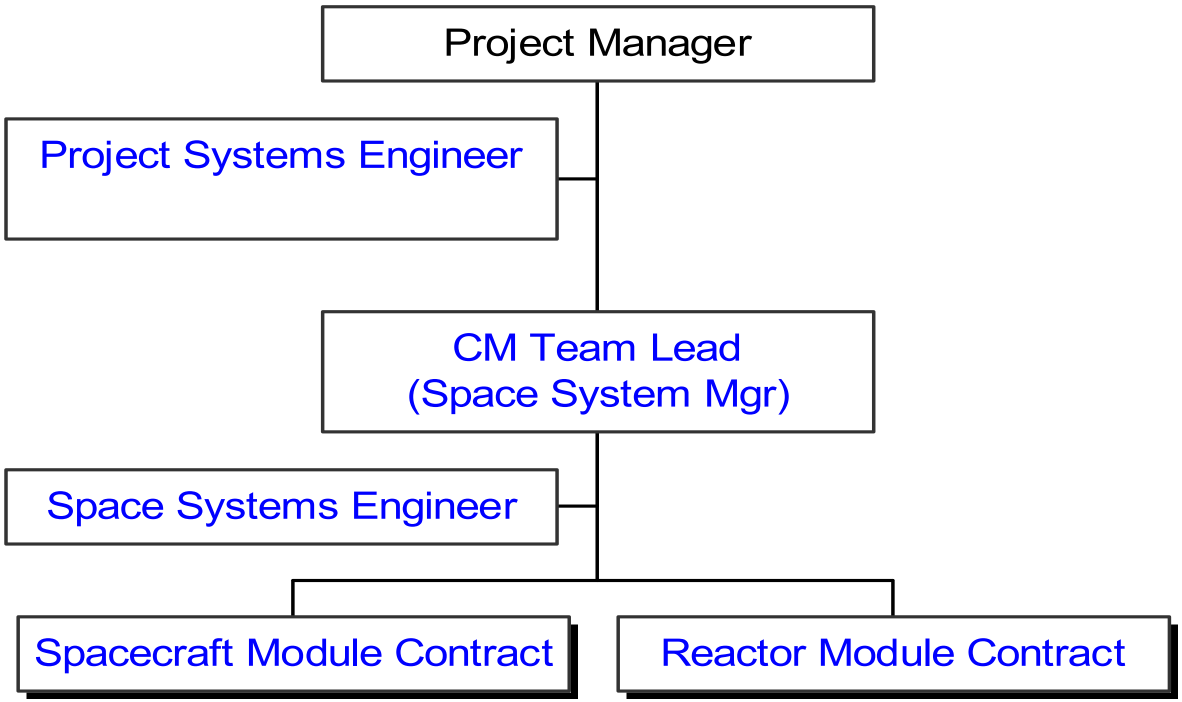
Contract Management Team (CMT)

- The JIMO project office will form a single integrated contract management team (CMT) to manage the 2 major Phase B/C/D contracts
  - These contracts have critical design interdependencies, and
  - an integrated contract management approach is critical to mission success
- The team consists of the following:
  - Space system manager: CMT lead reporting to the project manager
  - Project system engineer
  - Space system engineer
  - Contract Technical Manager (CTM)/Contracting Officer (CO)/Contract Technical Advisor (CTA) for the reactor module
  - CTM/Contract Negotiator (CN) for the spacecraft module/space system integration
  - Other CMT support staff as necessary
- This team is co-located at JPL

National Aeronautics and Space Administration

Contract Management Team

Jet Propulsion Laboratory
California Institute of Technology



Contract Management Team

CMT Lead
Reactor CTM
Reactor CO
Reactor CTA
Reactor TM
Instr. & Ctrl TM
Reentry Shield TM
Radiation Shield TM
Reactor CTR
S/C CTM
S/C CN
Power Converter TM
Heat Rejection TM
Ion Propulsion TM
S/C Bus TM
S/C Systems Engr
Project Systems Engr.
Flight Software TM
S/C CTR

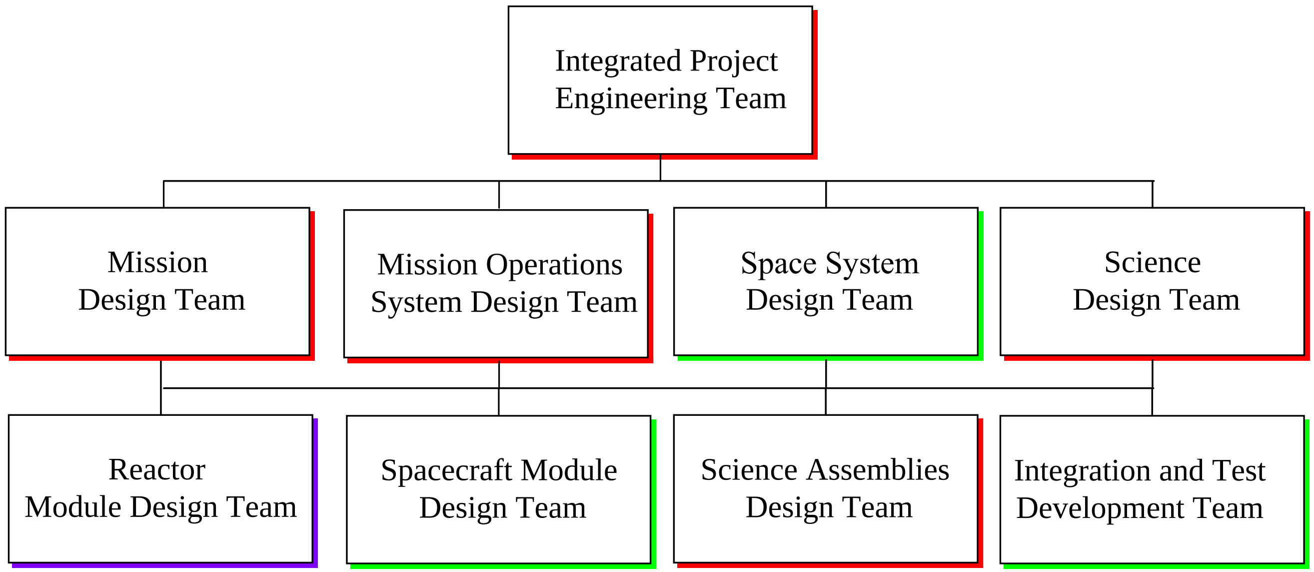
CMT Charter

- Integrated CMT to manage the 2 major contracts
  - Ensures flow-down of project/mission requirements and space system requirements to the 2 contracts (reactor module and space system module)
  - Ensures quality and completeness of interfaces between the reactor module and the spacecraft module/space system integrator
  - Ensures appropriate surveillance and technical direction
  - Ensures that risk management (identification & mitigation) is adequately used throughout the spacecraft module and reactor module development efforts
  - Ensures that safety is always the #1 consideration in development
- Ensures that risk management plans/approaches from the reactor module and spacecraft module contractors are consistent with an integrated JIMO risk management approach
- Ensures that separate reactor module and spacecraft module cost and earned value systems are consistent with and can be integrated into a JIMO project status report
- Ensures that critical issues in one contract are evaluated for impact to the other
- Facilitates the resolution of issues between the 2 contracts
- Ensures that resources are made available to supplement module contractors with personnel/facilities from NASA centers, DOE and/or JPL to support their development to ensure mission success

Jupiter Icy Moons Orbiter Systems Engineering Summary

- Major challenges for the Systems Engineering program are
  - Complex deep space mission with new technologies
  - Multiple systems provided by various organizations
- JPL will lead the SE program with active participation from the Science Team, system contractors and government partners
- SE will have a well defined, hierarchical structure
  - Integrated Project Engineering Team (IPET), led by the JPL Project Systems Engr., provides overall technical leadership
  - "Badgeless" team with senior representatives from systems providers and integrating disciplines
- JPL systems engineers will be be members of the Contract Management Team (CMT)
  - Provide technical insight of the designs of the system providers
  - Establish configuration management for technical designs

Jupiter Icy Moons Orbiter Systems Engineering Summary



- Senior representatives from the science team and system providers are members of the IPET
- Representatives communicate technical decisions and status between the IPET and design teams
- SE processes will be compliant with JPL Flight Project Practices & "Design Principles"
- Procedures will come from JPL & systems providers "best practices"

Key Functions of SE

- Define & maintain mission architecture & operational concept
- Develop the project's requirements
- Support system designs & interface definition
- Conduct mission trade studies and analysis
- Track system performance and manage technical resources
- Lead project's verification and validation program
- Provide configuration management of project information products

Jupiter Icy Moons Orbiter

Request for Proposal

K. Hahn

Pre-Proposal Briefing
February 18, 2003

RFP for Study Contracts

- JPL's intent is to maximize practical competition among qualified and responsible companies that can eventually compete for the future development and integration of the JIMO space system
- JPL will award multiple FFP study contracts to aerospace companies possessing the following 3 qualification criteria:
  - Must have spacecraft system engineering experience and capability in disciplines such as fluids, mechanical, thermal, electrical, radiation, software, and instruments;
  - Must have capability and past experience in designing, fabricating, testing, and physically integrating a large, complex flight system of at least 5000kg; and
  - Must be U.S. owned and located, and provide a U.S. domestic end product.
- Three companies have been identified as possessing these qualifications –
  - Boeing, Lockheed Martin Space Systems, and Northrop Grumman
  - Other companies have been offered an opportunity to demonstrate that they too meet these qualifications.

Solicitation Approach

- Recipients of the Final RFP will be required to submit a cost proposal and to provide a brief viewgraph presentation of their Technical Approach to the requirements of the Specimen Contract prior to Contract award
- Expedited procurement schedule to make more time available for performing the trade studies
  - Early submittal of rate tables to be used in the cost proposal
  - Authorization for the DCAA to release information to JPL
  - Minimize exceptions to the Contract Terms & Conditions
  - Submit Representations and Certifications (RFP Attachments) as required by the RFP
  - Work with us so that we can provide contractual coverage and get started on the trades as quickly as possible
- Near-Term Schedule Goals
  - Final RFP issued on 2/21
  - Rate tables and DCAA authorization received by 3/3
  - Technical Approach Presentations 3/10-18
  - Cost Proposals due on 3/24
  - Negotiations during week of 4/14
  - Contractors Kick-off Meeting 1 week after Contracts are issued

PROTOCOLS

- Single point of contact for this procurement is the responsible Contract Negotiator, Kathleen Hahn
  - Contact the negotiator to update company information
  - Submit questions in writing to the negotiator
    - FAX (818) 393-4168, E-mail: kathleen.g.hahn@jpl.nasa.gov
    - JPL Mail Stop 190-220
  - Do not request or accept information from any source other than the negotiator
    - Ensures all sources will receive the same information
    - The information discussed during the one-on-one sessions will be considered confidential. However, if we discover something significant regarding technical or RFP requirements, that information will be disseminated to all proposers.

Resources For Contractors

- Study Reports (Pre-JIMO, NSI Sponsored)
  - Jupiter Icy Moons Tour (JIMT) Mission Study Reports
  - Space Reactor Design Data Packages
    - Available at issuance of Phase A study contracts
- Selected In-house JIMO study products during Phase A as appropriate
- Information on X2000 electronics
  - Industry briefing packages, status, plans, capabilities, specifications
  - Flight computer performance characterization study results
  - Periodic informational updates during Phase A study as appropriate
- Informational briefings as requested by study contractors

Jupiter Icy Moons Orbiter

Statement of Work and Exhibits

H. Price and K. Clark

Pre-Proposal Briefing
February 18, 2003

Statement of Work Overview

• Provide a detailed Study Work Plan	10 days ADC
• Develop first order conceptual Space System design	5 months ADC
• Select a Reactor/Converter option(s)	5 months ADC
• Conduct a 1-day Midterm Review	5 months ADC
• Develop detailed Space System design	10 months ADC
• Submit Space System Conceptual Design report	10 months ADC
• Conduct a 2-day Conceptual Design Briefing	10 months ADC

Statement Of Work

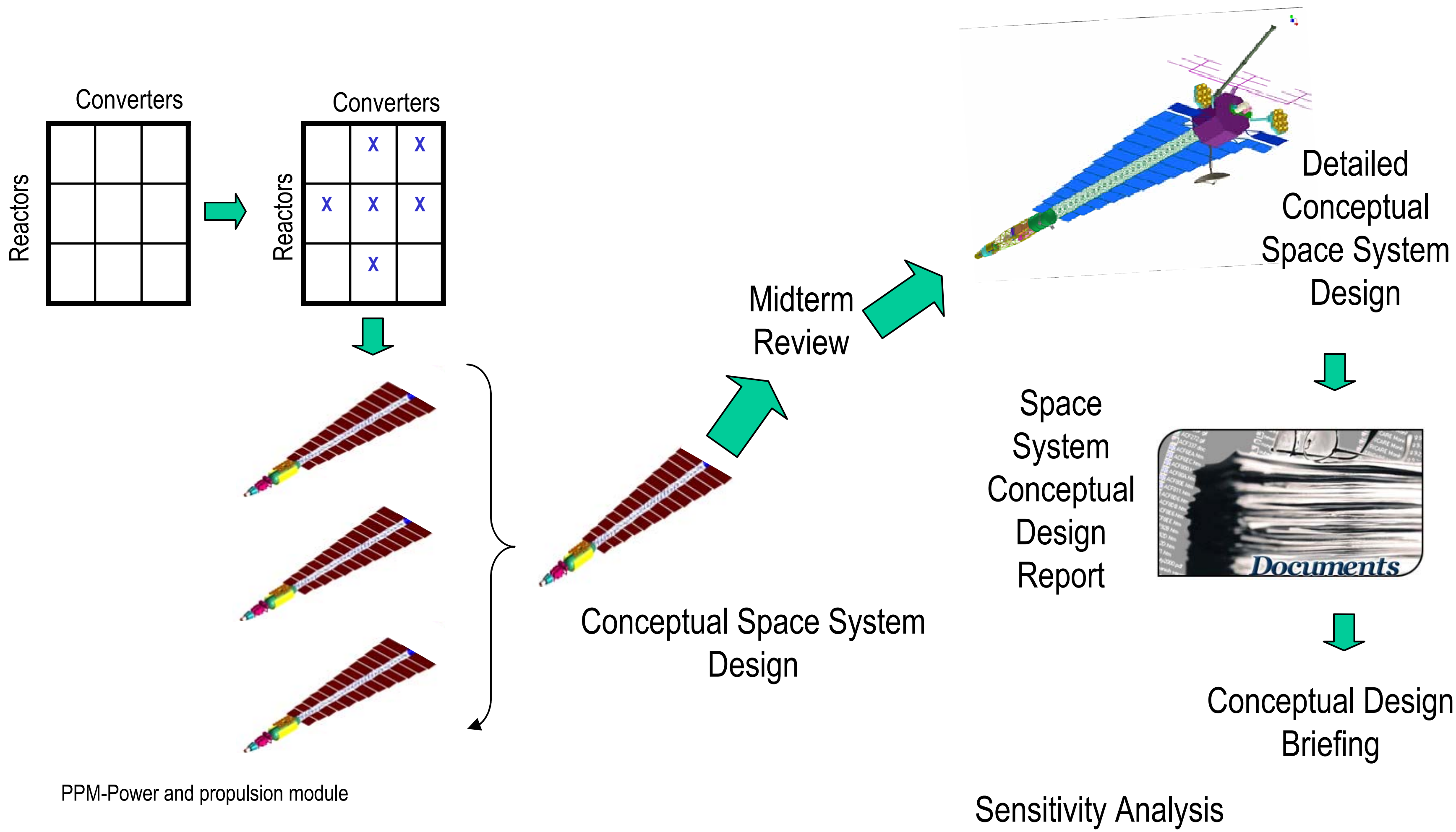


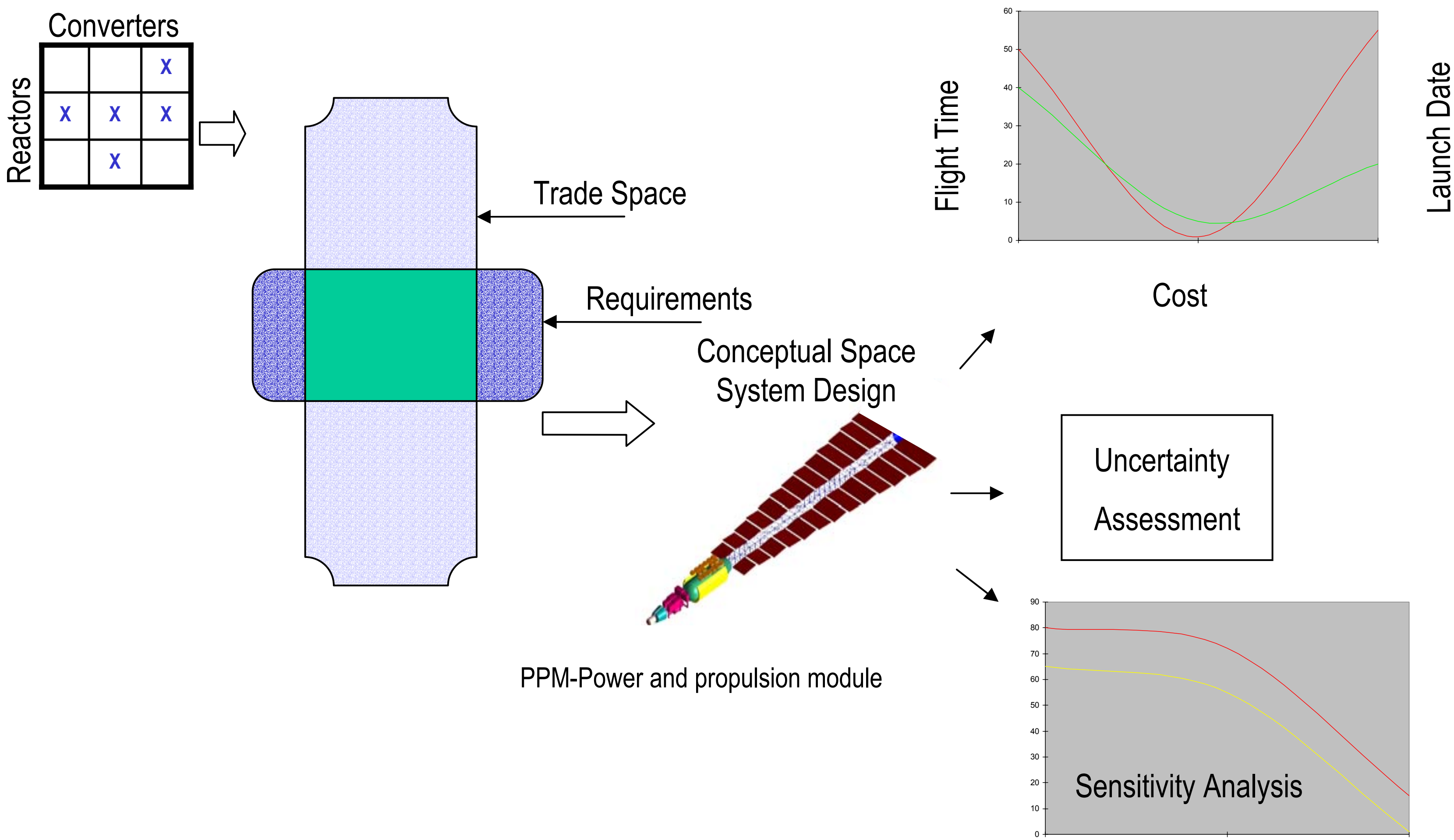
Exhibit 1 - Requirements, Assumptions, and Constraints

- Nuclear Safety
  - Safety is the absolute highest priority.
  - The spacecraft will be launched with the reactor inactive
  - Nuclear safety must be assured for all mission phases: prelaunch, launch, Earth orbit, Earth spiral out, transit to Jupiter
- Key Mission Requirements:
  - Single launch
  - Single fault tolerance
  - Science payload mass of 600 kg, including scan platform(s), turntable(s), booms, instrument, probe(s), and lander(s)
  - High data rates (10 Mbps returned from a distance of 6.2 A.U.)
  - High inclination, low altitude orbits of Callisto, Ganymede, & Europa
  - Lander at Europa: delivery to accuracy of 100 km footprint on surface
  - Stable Europa orbit at EOM

National Aeronautics and Space Administration

Exhibit 2 –Conceptual Design Trade Process

Jet Propulsion Laboratory
California Institute
of Technology



Conceptual Design Trade Space

- The Contractor shall consider each pairing of reactor type and converter type listed below

Space System Trades	Trade Options (minimum set)
1. Reactor Type	▪ Gas Cooled ▪ Heat Pipe Cooled ▪ Liquid Metal Cooled
2. Converter Type	▪ Brayton ▪ Stirling ▪ Thermoelectric

- Other trade space parameters:

Launch Vehicle:	Atlas V Heavy and improvements
	Delta IV Heavy and improvements
Injection Altitude:	1000 km and higher
Electric Propulsion Power:	100 kWE to 300 kWE
Electric Propulsion Thruster Isp:	2000 sec to 9000 sec

Trade Study Guidelines

- Results
  - Results shall include the cost as a function of Flight Time and Launch Date. Emphasis should be given to minimizing flight time.
  - Preliminary trade study results shall be made available at the mid-term review for a minimum of 2 reactor types (each reactor can have a primary and secondary converter type associated with it).
  - At the Midterm Review, the Contractor shall select a Reactor/Converter type to proceed through the detailed conceptual design. An alternate converter design may be carried at the Contractor's option.
- Assessment
  - Provide an assessment of the selected design(s) in terms of safety, development uncertainty, cost uncertainty, schedule uncertainty and performance uncertainty.
- Sensitivity
  - Assess the sensitivity of the flight time, cost and launch date to the trade space parameters.
  - Of particular interest is how sensitive the flight time and cost are to payload mass, reactor power, thruster Isp, and launch vehicle capability.

JIMO Phase A RFP Deliverables (Technical)

- Space System Conceptual Design Report
  - End-to-end space system conceptual design, including reactor (not including science instruments because these are GFE)
  - Ground test facilities requirements for the conceptual design, including reactor
  - Technology trade study results
- Conceptual Mission Operations Concept
- Preliminary reactor and fuel performance specification
- Recommendation on reactor and power conversion type
- Some products are required in final, preliminary, draft, or partial format at Midterm Review

Exhibit 3 - JIMO Phase A RFP Deliverables (Programmatic)

- Development plans and schedules
  - Keyed to launch in 2011, 2012, or 2013
- Development cost estimates
  - Space system (reactor, and non-nuclear elements)
  - Ground test facilities
  - Includes basis and assumptions of estimates
  - Includes support to JPL and independent estimates
- Development risk assessments
  - Technical, schedule, cost
  - Mitigation strategies

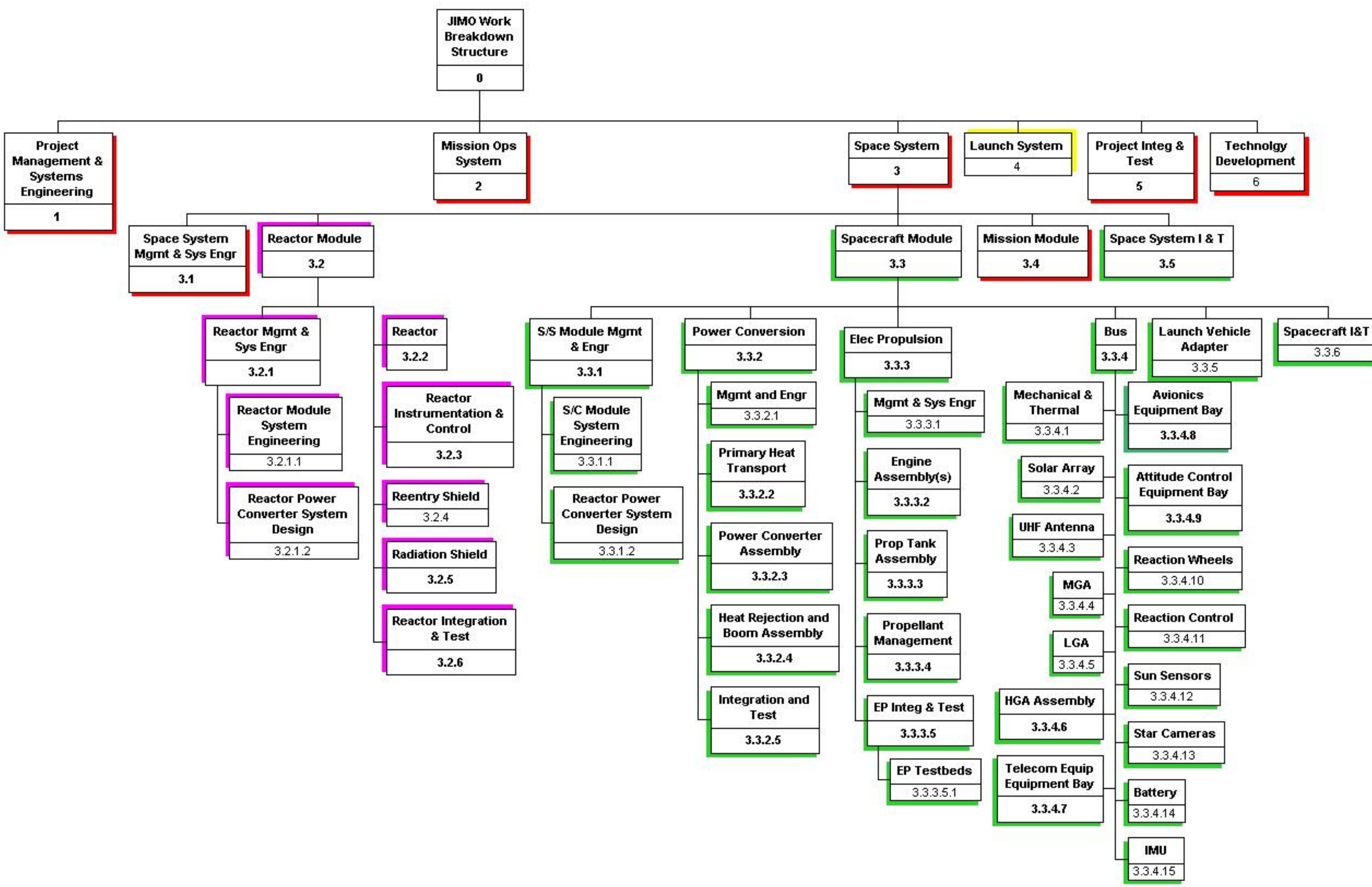
Exhibit 4 - Work Breakdown Structure (WBS) Description

- The program WBS (levels 1 - 3) may not be changed.
- The specimen expansion below level 3 is provided for reference only.
- The Contractor is to expand the WBS for the Reactor Module and the Spacecraft Module to level 6 or lower as appropriate to the study.
  - In developing the WBS to lower levels the Contractor shall refer to MIL-HDBK-881 2 January 1998 for guidance.
- Cost estimates developed by the Contractor in the Phase A study will be provided for each element in the WBS to level 6

National Aeronautics and Space Administration

JIMO WBS Diagram

Jet Propulsion Laboratory
California Institute of Technology



Program WBS (Levels 1 - 3)

Specimen Project WBS Provided for Reference Only

Exhibit 6,7 – Radiation, X2000

- The Europa radiation environment is a significant challenge to designing a survivable Space System
- X2000 Avionics
  - Specifically designed for radiation environment around Europa
  - Computer, databus interfaces, 28V power electronics
  - Designs based on radiation hardened ASICs
  - Components at various stages of development
  - All completed through Engineering Models and integrated subsystem level testing by end of FY 04
  - Alternate architectures considered if benefit shown